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OCEAN FISHERY PRODUCTS AND THEIR INLAND TRANSPORT IN LESS DEVELOPED AREAS

(A multi-disciplinary approach for delivery of protein from the sea to the inland consumer)

by

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SUMMARY

1. Many of the protein-starved areas of the world are located in coastal nations to which the living bounty of the sea is available. Yet these countries harvest only a relatively small percentage of their offshore fishery resources, primarily for immediate local consumption, while large segments of their burgeoning populations suffer continuously from a severe dietary deficiency of animal protein. What can be done to increase use of the many varieties of available marine food, to improve fish handling and processing facilities, and to provide efficient transport of fish protein to isolated inland markets? This paper suggests that a systems approach is required to what is essentially a complex interdisciplinary problem of supplying animal protein from the sea in the right form to the right place, and at reasonable prices.

2. Factors considered of major importance to the expansion of fishery resources in Peru, West Africa, India, and Southeast Asia are discussed.

3. At every stage the fishing industry urgently needs modernization. Larger powered vessels are needed to handle modern gear and equipment. Processing losses and fish spoilage account for a large proportion of the catch. Transportation routes and techniques are inadequate even for more durable commodities.

4. The similarity of symptoms in these representative areas masks a wide variety of underlying causes. There is no single magic formula for increased economic utilization of marine resources in coastal and inland areas since there is no single set of problems to be overcome.

5. One road to fuller utilization of marine resources is to build, piece by piece, on the existing industry, incorporating new technical processes and marketing methods in a program geared to overall modernization. Technical and organizational improvements in fisheries, however, may create serious economic and social dislocation, particularly in nations still dominated by traditional modes of life. Thus, the pace of development must be related to the sociological, religious and political factors of a less developed area.

6. Vital to the success or failure of fishery development programs is the degree of mobility and accessibility provided by regional and national transportation systems. Fishery projects and the speed with which they can be implemented are closely tied to the performance of existing transport facilities. Transportation, therefore, must be brought into the planning process from the beginning before rational choices can be made concerning the physical and financial requirements for specific fishery projects.

7. Particularly important are the advances in technology that will help reduce the drag of poor transport on fishery development. These potentials for transport innovations are essential ingredients of a total strategy for fishery development.

8. The development of safe, consistently uniform, high-quality protein concentrates from fish can have a considerable impact on other major aspects of marine food development and distribution. Spoilage losses from hot humid weather and infestation could be controlled at far lower costs, and basic market functions of transport, storage and retailing simplified considerably through obvious reductions in bulk and perishability.

9. Regardless of the path chosen -- building upon the traditional industry or introducing revolutionary change, or some combination of the two -- the many critical factors which interact and constrain each other in fishery development require a broad-based, integrated approach to insure their phased growth both as a systematic whole and in relation to the economic and social setting.

10. Although the less developed countries have a wide range of technological achievements available to them, concern for the totality of the development problem is required to adapt scientific techniques to the needs and aptitudes of a non-technological culture.

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UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: C.4.2

United States of America

BASIC PRINCIPLES IN WEED CONTROL AND THEIR IMPORTANCE IN CROP PRODUCTION

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Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

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BASIC PRINCIPLES IN WEED CONTROL AND THEIR IMPORTANCE IN CROP PRODUCTION

by

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1. From the time man started cultivating crops, energy was required to control weeds. The first effort was pulling them out of the soil by hand. Then various tools were developed to make the hands more efficient. Man then developed cultivation tools that he or animals could pull through the soil. Farm tractors provided more power for cultivating crops, and facilitated great advancements in weed control. Mechanical methods in combination with good agronomic practices, such as use of weed-free crop seed, proper crop rotation, fertilization, and other production practices, are essential to effective weed control.

2. The sequence of events that occurs in plant successions when native vegetation is disturbed or cultivated fields are abandoned has been established in many parts of the world. Weeds and other types of undesirable vegetation comprise early stages in plant successions that terminate in the climax vegetation. This vegetation will not supply the food and fiber required by the world's population. The control of weeds is a basic, essential, and important factor in reversing this fundamental ecological process (10, 11).

3. Production efficiency, crop quality, and yields are greatly increased by the use of effective cultural, mechanical, chemical, and biological practices to control weeds. Choice of a method or combination of methods of control depends on the crop, weed population, climate, soil, topography, and economic feasibility.

4. The discovery of the herbicidal value of 2,4-dichlorophenoxyacetic acid /2,4-D/ in the early 1940's showed that chemical energy could be applied to weed control and led to evaluating the herbicidal properties of literally thousands of chemicals. As a result, instead of the only 3 or 4 herbicides of commercial significance in 1945, more than 100 organic chemicals are now in use as herbicides. These advances in herbicide technology resulted from the close cooperation of scientists of many nations.

5. Biological control of weeds by insects and diseases has not received adequate attention. Outstanding examples of biological control of weeds with insects include the control of prickly pear cacti (Opuntia spp.) in Australia and Hawaii by Cactoblastis cactorum, and the control of Klamathweed (Hypericum perforatum) in California, Oregon, and Washington by three beetles (Chrysomela spp.) (3,4,7). Research in this area is being expanded. At present several candidate insects are being evaluated for their specificity to certain weeds and the results to date are very promising.

CONTROL METHODS AND PRACTICES

6. The present trend in the United States is to use a greater variety of herbicides and to apply specific ones for controlling specific weeds in specific crops and specific areas. The new herbicides offer almost unlimited potential for selectively controlling weeds in most crops. A few examples of chemical weed control practices for field crops, for horticultural crops, on forage and rangeland, and for aquatics and on noncroplands will show the stage of development.

Controlling Weeds in Field Crops

7. Lowland rice is grown under conditions very favorable for growth and reproduction of terrestrial, semiaquatic, and aquatic weeds. Most weeds that infest rice

produce an abundance of viable seeds and once they infest the soil they are difficult to remove. The best approach is to prevent weed infestations by planting weed-free rice seed and to remove scattered weed seedlings before they produce seeds. If after the soil does become infested, the weeds may be effectively and economically controlled by cultural and chemical methods.

8. Rice growers control weeds chiefly by cultural methods. Adequate seed-bed preparation combined with judicious use of water is vital in a weed control program. However, even with the best agronomic practices some weeds are more effectively controlled by the use of herbicides. Broadleaved weeds and certain sedges in rice can be controlled with 2,4-D; 2-methyl-4-chlorophenoxyacetic acid (MCPA); 2,4,5-trichlorophenoxyacetic acid (2,4,5-T); and 2-(2,4,5-trichlorophenoxy) propionic acid (silvex). The reaction of rice seedlings to phenoxy herbicides depends on their morphological stage of development. Rice is least sensitive to post-emergence herbicides during the late-tillering stage, usually 7 to 9 weeks after germination.

9. A recently introduced herbicide 3,4-dichloropropionanilide (DPA), now commercially available, has proved highly effective for the control of barnyardgrass (Echinochloa crusgalli), other annual weed grasses and sedges, and broadleaved weeds in rice fields. This herbicide is used after the weeds emerge and is most effective on the weeds soon after they emerge (12). Rice is not injured by DPA at any stage of growth. In recent studies it was shown that the rate of application required to control barnyardgrass could be considerably reduced by adding a surfactant to the spray. In 1961, DPA was tested on 20,000 acres of rice by 400 commercial growers in five States. Reported gains as a result of treatment ranged from 325 to 5,300 pounds of rough rice per acre. The average gains reported in the five States ranged from 1,046 to 1,989 pounds (1).

10. Weeds differ in their response to different herbicides. Therefore, when several species are present in a rice field, mixtures of herbicides may be used advantageously.

11. Important advances have been made in developing improved cultural, mechanical, chemical, and combination methods of controlling weeds in sugarcane. The substituted phenylureas, s-triazines, phenylacetic acids, benzoic acids, phenoxyalkylcarboxylic acids, trichloroacetic acid (TCA), 2,2-dichloropropionic acid (dalapon), pentachlorophenol (PCP), and other herbicides can be used effectively on a large variety of weeds in sugarcane. Herbicides are applied as pre-planting soil-incorporated, pre-emergence, post-emergence, and lay-by treatments. These herbicides when combined with appropriate cultural practices will control a large variety of weeds in sugarcane.

12. Intensive efforts are being made to use chemicals to control weeds along fence rows, ditchbanks, head rows, and irrigation and drainage canals to prevent the reinfestation of sugarcane fields. Herbicides also are being combined with fallow plowing for the control of deep-rooted perennial species such as Johnsongrass (Sorghum halepense) and nutsedge (Cyperus rotundus). Choice of the appropriate herbicide, mixture of herbicides, rotation of herbicides, methods of application, and cultural practices to use for weed control in sugarcane and along fence rows, ditchbanks, head rows, and in the fallow portion of the rotation is greatly influenced by climate, soils, weed population, and a wide variety of cultural practices which differ greatly in the various sugarcane production areas.

13. For nearly 50 years herbicides have been used on Hawaiian sugar plantations. In 1960, Hawaiian sugarcane producers spent more than 7 million dollars for herbicides and their application to control weeds. Even though the per acre cost of weed control in sugarcane was high, the increased yield resulting from this practice has proven to be profitable. The use of herbicides in sugarcane has greatly reduced the amount of hand labor required to control weeds and resulted in higher yields and higher quality.

14. The ability to control weeds in corn by herbicides has been enhanced by the development of the s-triazines. These compounds incorporated in the soil before planting or applied pre-emergence after planting provide weed control for 4 to 8 weeks, which gives time for the crop to become established. In many of the lowland Tropics the climatic pattern of dry periods followed by rainy periods determines whether modern machinery can be used to control weeds. Corn is planted at the beginning of the rainy season. The problem is to get the corn to germinate simultaneously with the weeds. Generally, preparing land for corn planting before the first rains is a waste of time, because the first rains may not provide enough moisture for corn germination but are sufficient for the weeds to start. So by the second rain weeds are so abundant that land preparation must be repeated. The rains may then be so frequent and the land becomes so wet that adequate mechanical cultivation for weed control becomes impossible. A pre-planting application of one of the s-triazines which could be incorporated into the soil at the end of the dry season should be investigated. When the rains start weeds would be controlled, and the corn could be planted by any method available. Abundant growth of grass when corn is in the early stage of growth reduces yield.

15. It is estimated that losses from weeds in cotton production exceed 440 mill-

ion dollars each year in the United States. The development of improved chemical-cultural methods of weed control in cotton has greatly improved the efficiency of production. Herbicides are applied as pre-planting, soil-incorporated, pre-emergence, early post-emergence, and lay-by treatments in combination with various cultural practices for full-season weed control in cotton. Ethyl N,N-di-n-propylthiolcarbamate (EPTC) as a pre-planting, subsurface soil-incorporated treatment has proved effective for the control of such perennial species as nutsedge and Johnsongrass, as well as a number of annual broadleaved weeds and weedy grasses. 3-(3,4-dichlorophenyl)-1,1 dimethylurea (diuron) as a pre-emergence treatment has also proved highly effective for the control of most annual weeds in cotton production, but is not effective in controlling deep-rooted perennial species. Herbicidal oils are widely used as early post-emergence treatments for the control of annual weeds that are not controlled by pre-emergence treatments.

16. Recent research has resulted in the development of residual type herbicides which may be applied as directed post-emergence treatments that will kill emerged weeds and possess enough residual activity to prevent the emergence of late-season weeds. Herbicides such as diuron, 2,4-bis(isopropylamino)-6-methylmercapto-s-triazine (prometryne), and combination treatments such as diuron plus surfactant and N-(3,4-dichlorophenyl) methacrylamide (DCMA) plus disodium monomethylarsonate (DMA) applications have proved effective as directed post-emergence sprays and as residual treatments at lay-by. When these herbicides are used in conjunction with thorough seedbed preparation, mechanical hill dropping to a stand, cross cultivation, and shielded and unshielded cultivation, full-season control of most weeds can be obtained in cotton production. Studies on the cost of controlling weeds in the United States have shown that is costs an average of $20 per acre for hand hoeing and other conventional methods of weed control requiring an average of 27 man-hours per acre, as compared to a cost of $13 and 12 man-hours per acre using combination chemical-cultural methods. These studies indicate that cotton producers can save approximately $5 to $10 per acre and reduce the number of man-hours required for weed control by one-half if chemical methods of control are used instead of conventional methods.

17. In the production of small grains such as wheat, oats, barley, and rye, weeds cannot be controlled effectively by mechanical methods. Adequate labor for hand weeding in these crops in the United States is not available and would not be practical. The phenoxyalkylcarboxylic acids such as 2,4-D; MCPA; 2,4,5-T; silvex; and 4-2 (2,4-dichlorophenoxy)butyric acid [4-(2,4-DB)] have proved highly selective and effective in controlling broadleaved annual and many perennial weeds in small grains.

18. The phenoxy herbicides are usually applied at the full-tiller stage of growth for maximum effectiveness in controlling weeds in small grains. Some of these herbicides often are used also as pre-harvest treatments to control weeds as an aid to mechanical harvesting of small grains. The recently introduced herbicide 4-(2,4-DB) is the best known phenoxy compound that can now be used for the control of weeds in small grains underseeded with legumes on more than 35 million acres of cropland in the United States (9).

19. Since 1947, more than 200 million acres of small grains have been treated with 2,4-D or related phenoxy compounds, increasing the yield of small grains by more than 800 million bushels of grain (8). The average cost of the herbicide and its application is about $1.75 per acre. Yield and quality losses have been reduced from approximately 20 to 13 percent of the value of the small grains, while the use of the phenoxy compounds has reduced the cost of weed control in these crops by more than 50 percent.

Controlling Weeds in Horticultural Crops

20. The control of weeds continues to be one of the most critical production problems in horticultural crops. Weeds in the row cause serious problems in many horticultural crops. Mechanical weeding equipment cannot be used effectively because of the proximity of the weeds to the crop plants. Much hand labor was used to remove these weeds in the past, but such labor is no longer available in many areas. Therefore, effective economical control of weeds must now depend largely on development of new and improved herbicides and techniques.

21. Selection of effective herbicides and cultural and mechanical methods of weed control for horticultural crops is highly complex, partly because of the large number of plant families, genera, species, and varieties involved. Some vegetable crops that formerly required 100 to 200 man-hours of hand weeding per acre can now be weeded chemically at less than one-tenth of the cost. For example, pre-emergence applications of a combination of 2-chloroallyl diethyldithiocarbamate [CDEC] and isopropyl N-(3-chlorophenyl)carbamate [CIPC] are used for controlling weeds in spinach, lettuce, broccoli, and several other important vegetable leaf, salad, and cole crops. Pre-emergence applications of 4,6-dinitro-o-sec-butylphenol [DNBP] effectively control weeds in sweet corn and beans. Weeds that emerge after the last cultivation of transplanted crops such as tomatoes, peppers, and sweet potatoes are yielding to new herbicides, thiolcarbamates, acetamides, and substituted benzoic acids among them. Weeds in asparagus,

a perennial crop which formerly required intensive cultivation and hand weeding, can be effectively controlled by 3-(p-chlorophenyl)-1,1-dimethylurea (monuron). Candad thistle (Cirsium arvense), a weed that threatened the pea-processing industry, was recently brought under control with 4-(2-methyl-4-chlorophenoxy)butyric acid [4-(MCPB)].

22. In fruit and nut orchards weeds that harbor rodents, insects, nematodes, and other disease-producing agents, and compete for moisture and nutrients are being effectively controlled with fortified aromatic oil emulsions, DNBP, CIPC, diuron, 2-chloro-4, 6-bis(ethylamino)-s-triazine (simazine), and dalapon selected and applied in accordance with the problem weed species.

Weeds and Brush Control on Grazing Lands

23. Brush is a problem on grazing lands, where the climate ranges from very arid to humid subtropical. In the United States brush infests 320 million acres of range and pastureland. This about equals the acreage used for cultivated crops but is only one-third of the total area that is grazed. Species that infest extensive areas include junipers (Juniperus spp.) on 76 million acres; mesquites (Prosopis spp.) on 70 million acres; sagebrushes (Artemisia spp.) on 96 million acres, and prickly pear on more than 60 million acres. Thus, a wide range of species are involved, and the problems in developing control methods are diverse. It has been estimated that brush control would improve grazing on 240 million acres in the United States.

24. Weeds, brush, and poisonous plants cause tremendous losses in pastures and rangelands throughout the United States. For instance, in one eastern Nebraska pasture over two-thirds of the total production of plant material consisted of unpalatable weeds. The 3-year average yield of dry matter was 4,200 pounds; of this 2,300 pounds was broadleaved weeds and 700 pounds weed grasses (5).

24. Weed losses are not limited to the reduction in palatable forage available to livestock. Losses also result from weeds that impart undesirable flavors to dairy products, cause injury to grazing animals by thorns and briers, abortion, abnormal fetuses and in some instances cause death of livestock. Losses in animal production caused by sublethal poisoning often go undetected. For instance, an unusual abortion problem in beef and dairy cattle grazing on unimproved lowland pasture in Wisconsin went unsolved for at least 50 years. Research showed that sublethal dosages of nitrate in the weeds caused the abortions. Spraying these weeds with 2,4-D solved the problem.

25. Good management of livestock is virtually impossible on rangeland extensively infested with large mesquite or other trees. Controlling the brush with modern herbicides and other techniques facilitates the "rounding up" of cattle, the regular inspection and treatment of herds for diseases and insect disorders, and orderly culling and marketing of excess cattle. Saving the losses from inefficient handling of cattle in brush often would pay for the cost of control.

26. Some species of brush are efficiently removed mechanically. Moderately mature stands of juniper can be controlled by "cabling" on favorable sites. In deep rock-free soils, "root-plowing" in preparation for reseeding the area to grasses controls many species of undersirable woody plants. However, more efficient and versatile methods are being developed. Millions of acres of weed- and brush-infested rangelands are successfully converted to productive grasslands by use of herbicides. Woody plants can be controlled by applying herbicides to the foliage, to the bark, through cuts in the bark, and to the soil.

27. On most extensive areas of grazing land, the herbicides are applied aerially to the foliage of the undesirable weeds and brush. Ranchers in the Southern United States kill blackjack oak (Quercus marilandica) and post oak (Quercus stellata) with 2 or 3 annual aerial spraying of 2,4,5-T. Where an understory of grasses persists, forage production is increased 2 to 7 times as much (2).

28. Most species of sagebrush can be controlled satisfactorily with a single application of 2,4-D. However, repeated spraying is necessary to control many woody plants. Usually a single aerial spraying defoliates the trees, but within a few years they are again a serious problem. Therefore, it is important to study each species and each climatic condition in developing recommendations.

29. Undesirable woody plants may be controlled effectively by applying herbicides to the bark at the base of the trunk. Esters of 2,4,5-T and 2,4-D dissolved in diesel oil or kerosene effectively kill many kinds of undersirable brush during any season of the year. Basal sprays are more effective on plants 4 inches or less in diameter than on larger thick-barked ones. If the plants have a thick bark it may be necessary to cut through the bark to the sap wood so that the herbicide can be applied to the cambium layer. Basal sprays are particularly adapted for use on scattered stands of trees or where a broadcast spray likely would injure plants in adjoining areas.

30. Herbicides applied to the soil as dry granules or as sprays can kill woody plants. Application of 3-phenyl-1,1-dimethylurea (fenuron) pellets at the base of alligator juniper (Juniperus pachyphloea) has given good control and is being adopted for control of scattered stands of this species.

31. Proper agronomic practices are critically important for brush control on rangeland and may be equally as important as finding herbicides or other methods of

killing brush on grazing land. There must be at least a moderate stand of desirable forage species where brush control practices are to be applied if seeding of new species is not contemplated.

32. In many areas in the United States experience has shown that grazing should be greatly reduced or deferred during 1 or 2 grazing seasons after brush control to allow the desirable grasses to thicken. The residual grass can be grazed during winter. Fertilization and seeding of forage species may be necessary where dense brush is controlled, because such a dense stand usually contains little residual grass.

Weed Control in Aquatic and Noncrop Areas

33. Aquatic weeds, bank weeds, and phreatophytes cause tremendous losses annually to crop production in the United States and many other countries. Aquatic weeds grow submersed in, floating on, or emersed from water in irrigation and drainage canals, in reservoirs, and in farm ponds. Bank weeds grow at the waterline or immediately above, with their roots extending into the saturated or moist soil. Phreatophytes grow along streams, canals, or reservoirs and on river flood plains and habitually obtain their water from the ground water table or the capillary fringe immediately above (13).

34. Floating weeds such as water-hyacinth (Eichhornia crassipes) may reduce the flow of water in canals as much as 40 percent while submersed waterweeds such as naiads (Najas spp.) and pondweeds (Potamogeton spp.) may reduce it as much as 97 percent. Reduced flow makes water levels high in canals and streams and results in flooding, seepage into adjoining areas, breaks in canal banks, greater losses from evaporation, and inadequate delivery of irrigation water to farms or inadequate drainage of water from farms. In addition, decreased velocity of flow caused increased sedimentation, which reduces carrying capacity and makes more frequent mechanical cleaning necessary (13).

35. Aquatic weeds such as cattails (Typha spp.) and phreatophytes transpire water from canals, reservoirs, and the ground water table into the air and thus reduce water supplies.

36. The traditional methods of controlling aquatic and bank weeds in the United States include hand cutting or pulling, mechanical mowing, chaining, dragging, or crushing. These methods are still in use in many areas but where extensive weed infestations are prevalent in areas of high labor cost, the hand and mechanical methods are slow and expensive and are being replaced by improved chemical methods.

37. Discovery and development of aromatic solvents for the control of submersed weeds in irrigation channels were among the first achievements. The use of xylene increased rapidly in the Western United States after 1952 and 580,000 gallons were used in 1957. The use of xylene in these States in 1962 for control of aquatic weeds resulted in more than a million dollar saving as compared with the cost of controlling submersed weeds by previously used mechanical methods.

38. Cattails may be controlled by spraying with a low volatile ester of 2,4-D in an oil-water emulsion for 3 applications per year over a 2-year period. Dalapon and 3-amino-1,2,4-triazole (amitrole) alone or in combination have also proved effective in controlling cattails.

39. New herbicides have been discovered in the United States that show promise of effective and economical control of aquatic weeds in reservoirs, ponds, and lakes without killing fish or other desirable fauna, and some of these may be more suitable than aromatic solvents for use in irrigation and drainage canals. The search for even safer herbicides is being intensified.

40. The chemicals most commonly used for selective control of broadleaved weeds and woody plants on ditchbanks and around reservoirs, ponds, lakes, and flood plains are 2,4-D; 2,4,5-T; silvex; and 2,3,6-trichlorobenzoic acid (2,3,6-TBA). The tolerance of weed species to these herbicides varies considerably. Amitrole and dalapon are used for selective control of troublesome perennial grasses and sedges. Mixtures of amitrole or dalapon with 2,4-D or other phenoxy herbicides are commonly used for control of mixed vegetation consisting of undesirable dicotyledons and monocotyledons. In many areas where the use of phenoxy herbicides is prevented or limited by the proximity to cotton, grapes, or other sensitive crops, spraying with aromatic oils or fuel oils often fortified with PCP or DNBP is used extensively for general control of ditchbank vegetation. Soil-sterilant herbicides such as the phenylureas, the s-triazines, the chlorates or borates, and mixtures of these are used only in canals and ditches and on banks where their use does not produce a soil-erosion hazard. Ordinarily such herbicides should not be used on steep banks especially those consisting of gravelly or sandy soils or in ditches with rapidly flowing water.

41. Pasturing canals and ditchbanks with sheep, goats, or other livestock is frequently the most effective, least expensive, and most profitable method of controlling and managing vegetation. Fencing the canal or ditch right-of-way or herding or tethering the livestock along the channel usually is necessary. Pasturing is especially effective and profitable in combination with seeding of desirable species of grasses and legumes that compete strongly with undesirable weeds.

42. Limited research on the competitive effects of weeds in reducing crop yields and quality show that the loss is about 13 percent of the value of the crops produced each year. In addition to the losses caused by reduced yields and quality, the average cost of weed control in crops in the United States each year averages about 14 percent of their value (6).

43. As the science of chemical weed control advances greater consideration must be given to the development of overall weed control practices on the farm as a farm unit rather than limiting the development of weed control practices to individual crops. Farmers must be encouraged not only to use chemical weed control in the current crop, but to place greater emphasis on supplementing this program by the rotational use of herbicides on all tolerant crops throughout the rotation, thus preventing undesirable shifts in the weed population, and avoiding an accumulation of herbicide residues in the soil.

44. Where there is an abundance of farm labor available the question can be raised as to the necessity or practicality of adopting chemical weed control methods. Would not use of such methods simply add to the pool of people not gainfully employed? It is true that modern chemical weed control practices do substantially reduce the need for farm hands to hoe weeds from crops. Farm people not needed for hand weed control, especially the younger ones, would then have time to acquire basic education commensurate with their potential. Modern agriculture requires the application of new and developing science and technology. Those not qualified to accept such advancements hinder the world's efforts to feed an everexpanding population. Waste of natural resources cannot be tolerated if the goal of abundant food, feed, and fiber is to be achieved. Weeds take nutrients and water from the soil and compete with the desirable crop plants for light. Thus, they reduce both quantity and quality of desired crop plants. Therefore, they must be controlled. This control can be effected by good agronomic practices: use of weed-free seeds; appropriate crop rotations; application of fertilizer or manure when needed; cultivation to control weeds by the methods available; use of herbicides where knowledge is adequate for their safe adaptation and where the environment dictates the use of methods other than cultivation.

45. The application of these new technological advances will be reflected in increased supplies of food, feed, and fiber products that will help meet dietary requirements and improve standards of living in the world.

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